



HOKKAIDO UNIVERSITY

Title	ON THE PARASITISM OF HETERODERA SCHACHTII SCHMIDT ON BEANS
Author(s)	Kastumasa, Fujita; Osamu, Miura
Citation	札幌博物学会会報, 13(3), 359-364
Issue Date	1934-06-20
Doc URL	https://hdl.handle.net/2115/64082
Type	journal article
File Information	Vol.13No.3_045.pdf



ON THE PARASITISM OF HETERODERA SCHACHTII SCHMIDT ON BEANS

BY

KATSUMASA FUJITA AND OSAMU MIURA

(藤田勝正・三浦修)

In Hokkaido, the injury to beans by *Heterodera schachtii* has recently become serious, occurring in the provinces of Oshima, Iburi, Ishikari, Hidaka, Tokachi and Kushiro, prevailing particularly in the southern part of the island. A field survey conducted chiefly by the senior writer for three years from 1931 shows an infested area amounting to more than ten thousand acres.

The affection appears about two months after sowing. Growth of the affected plants is retarded severely, causing the foliage to turn yellow in color and to fall off early. As the result the plants bear only a few flowers, and a few seeds which are smaller in size and inferior in quality to the normal ones. In many cases, actually, a smaller yield than the seed sown has been harvested.

The occurrence of the nematode in Japan was first recorded by HORI (4) in 1915 who reported an attack on soy bean at Shirakawa, Iwaki Prov., referring the causal nematode to a species closely related to *Heterodera schachtii* according to the identification of S. UCHIDA. Since then, the occurrence of the same kinds of worm has been reported from Echigo Prov. by ISHIKAWA (5), from Hitachi Prov. by TANAKA (10), and from Hokkaido by Katsufuji (7) causing "yellow dwarf" disease which is named after the characteristic symptom of yellowish discoloration of the plant injured. Last year the nematode was found on the roots of soy bean in the provinces of Rikuchu and Mutsu in northern parts of Honshu by Messers KAGEYAMA and TERUI. Detailed symptoms, the geographical distribution, the host plants and the morphology of the nematode together with the remedial measures have been described by Ito (6).

However, in Europe a large number of plants have already been reported as susceptible to the attack of *Heterodera schachtii*. According to GOODEY (3) 92 species of plants in 62 genera covering 21 families have been attacked. Among them, 13 species of legumes are included. The occurrence of biologic strains, in connection with the parasitism, as expected naturally in such cases, has been

noted by LIEBSCHER (8), VOIGT (11), GOFFART (1, 2), SCHMIDT (9), etc. Up to present, the following four strains have been studied tolerably in detail, namely: beet strain parasitic on chenopods and crucifers, oat strain on cereals, potato strain on potato and pea strain on legumes. As each strain differs not only in the parasitism but also in the morphological characters to some extent, some of them have been sometimes considered even as a distinct species or variety or subspecies of *Heterodera schachtii*. GOODEY (3) summarized the outstanding investigations along this line up to 1933.

As to the parasitism of the nematode under question only a few facts have been known. KATSUFUJI (7) and ITO (6) reported that adzuki bean and kidney bean as well as soy bean are attacked by the nematode while some other investigators thought soy bean to be the only host plant. In the course of the field survey, the writers have paid special attention to learn the range of the host plants but have not yet found any beyond the above three kinds of bean. It is however very important from the economical as well as the scientific standpoint of view to ascertain experimentally the range of the host plants.

Under these circumstances, the writers have carried out a series of experiments at the Agricultural Experiment Station of the Hokkaido Government. The results so far obtained will be given as the following.

Experimental results

For the inoculation experiments four kinds of soils were used as follows:

No. 1. Soil naturally infested, taken from a soy bean field at Yuni-mura, Iburi Prov.

No. 2. Soil naturally infested, taken from a field of wheat planted with soy bean at Date-machi, Iburi Prove., in 1931.

No. 3. Soil naturally infested, taken from a soy bean field at Date-machi, Iburi Prov., in 1932.

No. 4. Soil inoculated with cysts developed on soy bean roots.

The soils were put into porcelain pots or earthenware cylinders, in which various crops were planted, and kept mostly in the green house, but partly out of doors.

Table 1. Results of inoculation experiments with soy bean nematode
Experiment 1. (June 2—July 13, 1931) •

Plant			Formation of cyst	Remarks
English name	Scientific name	Variety		
Soy bean	<i>Glycine Max</i> MERR.	Tsuru-no-ko	+++	This experiment was carried out in the green house, using soil No. 1.
Adzuki bean	<i>Phaseolus angularis</i> WIGHT	Kensaki	+	
Sugar beet	<i>Beta vulgaris</i> L.	Hon-iku No. 48	—	
Cabbage	<i>Brassica oleracea</i> L. var. <i>capitata</i> L.	Sapporo-kanran	—	
Pe-tsai	<i>B. pekingensis</i> RUPR.	Matsushima-hakusai	—	
Oat	<i>Avena sativa</i> L.	Victory No. 1	—	
Barley	<i>Hordeum vulgare</i> L.	Marumi No. 15	—	
Potato	<i>Solanum tuberosum</i> L.	Danshaku	—	
Soy bean	<i>Glycine Max</i> MERR.	Tsuru-no-ko	++	Soil No. 2 was used.
do	do	Shiro-shoryu	++	
Adzuki bean	<i>Phaseolus angularis</i> WIGHT	Maruha	+	
Kidney bean	<i>Phaseolus vulgaris</i> L.	Uzura	—	
do	do	Kintoki	—	
Pea	<i>Pisum sativum</i> L.	Aka-endo	—	
Radish	<i>Raphanus sativus</i> L.	Mino-wase	—	
Spinach	<i>Spinacea oleracea</i> L.	Long Standing	—	
Oat	<i>Avena sativa</i> L.	Victory No. 1	—	Soil No. 4 was used.
Barley	<i>Hordeum vulgare</i> L.	Sapporo-rokkaku	—	
Pea	<i>Pisum sativum</i> L.	Sapporo-ao-tenashi	—	
Sugar beet	<i>Beta vulgaris</i> L.	Hon-iku No. 48	—	
Kohlrabi	<i>Brassica oleracea</i> L. var. <i>caulorapa</i> PASQ.	White Vienna	—	
Wheat	<i>Triticum aestivum</i> L.	Sapporo-harukomugi	—	
Corn	<i>Zea mays</i> L.	Yellow Dent Corn	—	
Potato	<i>Solanum tuberosum</i> L.	Danshaku	—	

Experiment 2. (June 8—Aug. 3, 1931)

Soy bean	<i>Glycine Max</i> MERR.	Tsuru-no-ko	+	This experiment was carried on outdoors, using soil No. 2.
Pea	<i>Pisum sativum</i> L.	Sapporo-ao-tenashi	—	
Sugar beet	<i>Beta vulgaris</i> L.	Hon-iku No. 48	—	
Cabbage	<i>Brassica oleracea</i> L. var. <i>capitata</i> L.	Sapporo-kanran	—	

continued

Plant			Formation of cyst	Remarks
English name	Scientific name	Variety		
Kohlrabi	<i>Brassica oleracea</i> L. var. <i>caulorapa</i> PASQ.	White Vienna	—	
Oat	<i>Avena sativa</i> L.	Victory No. 1	—	
Barley	<i>Hordeum vulgare</i> L.	Sapporo-rokkaku	—	
Potato	<i>Solanum tuberosum</i> L.	Danshaku	—	

Experiment 3. (Aug. 3—Nov. 9, 1932)

Soy bean	<i>Glycine Max</i> MERR.	Tsuru-no-ko	+++	This experiment was carried on outdoors using soil No. 3.
Adzuki bean	<i>Phaseolus angularis</i> WIGHT	Maruha	+	
Kidney bean	<i>Ph. vulgaris</i> L.	Beni-kintoki	+	
Pea	<i>Pisum sativum</i> L.	Sapporo-ao-tenashi	—	
Sugar beet	<i>Beta vulgaris</i> L.	Hon-iku No. 48	—	
Rape	<i>Brassica Napus</i> L.	Kabafuto	—	
Oat	<i>Avena sativa</i> L.	Victory No. 1	—	
Potato	<i>Solanum tuberosum</i> L.	Danshaku	—	

Experiment 4. (July 30—Oct. 4, 1932)

Soy bean	<i>Glycine Max</i> MERR.	Nakate-hadaka	+	This experiment was carried out in the green house, using soil mixed together No. 1, 2 and 3.
do	do	Cha-shoryu	+	
Adzuki bean	<i>Phaseolus angularis</i> WIGHT	Wase-maruha	+	
Kidney bean	<i>Ph. vulgaris</i> L.	Tenashi-nagauzura	+	
Multiflora bean	<i>Ph. coccineus</i> L.	Murasaki-hanamame	+	
Lima bean	<i>Ph. limensis</i> MACQ.		—	
Pea	<i>Pisum sativum</i> L.	Marrow Fat	—	
Broad bean	<i>Vicia faba</i> L.	Otafuku	—	
Common vetch	<i>V. sativa</i> L.		—	
Peanut	<i>Arachis hypogea</i> L.		—	
Cow pea	<i>Vigna sinensis</i> ENDL.	Rokushaku-sasage	—	
Red clover	<i>Trifolium pratense</i> L.		—	
	<i>Lupinus albus</i> L.		—	
	<i>Lathyrus tingitanus</i> L.		—	

continued

Experiment 5. (July 31—Sept. 21, 1932)

Soy bean	<i>Glycine Max</i> MERR.	Rankoshi	+++	This experiment was carried out in the green house, using soil No. 3.
Pea	<i>Pisum sativum</i> L.	Sapporo-ac-tenashi	—	
do	do	Aka-endo	—	
do	do	Small Blue	—	
do	do	Ball Pea	—	
do	do	Best Extra Early	—	
do	do	French Canner	—	
do	do	Alaska	—	
do	do	Marrow Fat	—	

As shown in the above table, the soy bean nematode can infect soy bean, adzuki bean, kidney bean and multiflora bean, but can not attack the other legumes, chenopods, solanacees, crucifers, and graminees tested. Among the affected plants, soy bean was most severely attacked, while adzuki bean was always slightly attacked. As for kidney bean and mutiflora bean only a trace of affection was secured. It is evident, therefore, that the soy bean nematode is a distinct strain differing from the strains specialized on beet, oat, and potato. It is also clear that the present nematode differs from pea strain which is parasitic mainly on peas.

In addition to the above experiments the following cross inoculation experiments were performed in order to determine whether cysts developed on soy bean, adzuki bean, and kidney bean as well are really equal in respect to the parasitism. Soils sterilized by steam for forty minutes were inoculated (a) with 200 cysts collected from soy bean; (b) with 100 cysts collected from adzuki bean; (c) with 20 cysts collected from kidney bean. The inocula were all obtained from living plants in fields at Kotoni (Nov. 4, 1933). The experiments were performed twice in the green house, the first of which was carried out during the period Nov. 4, 1933—March 5, 1934, and the second from March 7 to May 8, 1934. The results of these experiments are shown in the following table.

Table 2. Results of cross inoculation experiments with cysts collected from soy bean, adzuki bean and kidney bean

Soil	Plants					
	Soy bean		Adzuki bean		Kidney bean	
	Exp. 1	Exp. 2	Exp. 1	Exp. 2	Exp. 1	Exp. 2
a	+	+	+	+	—	+
b	+	+	+	+	+	+
c	—	+	+	+	+	+

The above table shows that in Exp. 1 soy bean in soil (c) and kidney bean in soil (a) were not affected, but in Exp. 2 they were affected although only a few cysts were found on soy bean roots in soil (c). Apart from some small discrepancies as above it may be safe to infer that almost no difference exists among the three kinds of cysts tested, if we remember that the activities of the nematode in question are less in winter, when Exp. 1 was carried out, than in summer. Further investigations are going to be undertaken along this line.

Here the writers would like to express their thanks to Dr. S. Ito for his kindness in enabling us to carry out the investigation and in giving many valuable suggestions.

Literature cited

1. GOFFART, H.: Rassenstudien an *Heterodera schachtii* SCHM. I und II. Arb. B'ol. Reichsanst. Land- und Forstwirtschaft 18: 83-100, Illust., 1930.
2. ———: Untersuchungen am Hafernematoden *Heterodera schachtii* SCHM. etc., III. Beiträge zu: Rassenstudien an *Heterodera schachtii* SCHM. Arb. B'ol. Reichsanst. Land- und Forstwirtschaft 20: 1-26, 1932.
3. GOODEY, T.: Plant parasitic nematode and the diseases they cause: 306, 1933.
4. Hori, S.: Phytopathological notes. V. Sick soil of soy bean caused by a nematode. (in Japanese) Jour. Pl. Protect. 2: 927-930, 1915.
5. ISHIKAWA, T.: Principal injurious insects and diseases of plants occurring during the fourth year of Taisho. II. Occurrence of "Moon night" and wilt disease of soy bean. (in Japanese) Jour. pl. Protect. 3: 197, 1916.
6. ITO, S.: Studies on "Yellow dwarf" disease of soy bean. (in Japanese) Hokkaido Agr. Exp. Sta. Rept. 11: 47-59, 1921.
7. KATSUFUJI, K.: "Yellow dwarf" a new nematode disease of soy bean. Ann. Phytopath. Soc. Japan 1: 1-5, 1919.
8. LIEBSCHER, G.: Beobachtungen über das Auftreten eines Nematoden an Erbsen. Jour. Landw. 40: 357-368, Illust., 1892.
9. SCHMIDT, O.: Sind Rüben- und Hafernematoden identisch? Wiss. Archiv Landwirtschaft Abt. A, Pflanzenbau 3: 420-464, Illust., 1930.
10. TANAKA, T.: On soy bean nematode. (in Japanese) Jour. Pl. Protect. 8: 551-553, 1921.
11. VOIGT, W.: Beitrag zur Naturgeschichte des Rüben-, Hafer-, Erbsen- nematoden, *Heterodera schachtii*. Deuts. Landw. Pr. 19: 813-815, 1892. (originat not seen)